CHAPTER 1

ROTARY INVERTER, TYPE 100B (Rotax S.2902)

CONTENTS

ILLUSTRATIONS

LEADING PARTICULARS

Rotary inverter, Type 100 B	...Ref. No. 5UB/4935
Input	22 to 28V d.c.
Output	3-phase, 115V, 120W (0·8 p.f.)
Phase sequence (at output socket of inverter)	A-B-C
D.C. brushes	
Grade Nobrac LAB No. F2C	... Ref. No. 5UB/5958
Spring pressure	136 to 164 grammes (4·8 to 5·8 oz)
A.C. brushes	
Grade F2B	...Ref. No. 5UB/5959
Spring pressure	21 to 57 grammes (0·75 to 2·0 oz)
Resistors	
Shunt field (40 ohms) Type ZA.4801/1	...Ref. No. 5UB/6085
Trimmer (500 ohms)	...Ref. No. 5UB/6297
Ballast (1000 ohms)	...Ref. No. 5UB/6819
Rotation (viewed from commutator end)	..Counter-clockwise
Dimensions	
Height	7·740 in
Length	7·375 in
Width	5·812 in
Weight	10 lb
Plug, d.c.	Ref. No. 5X/6001
Plug, a.c.	Ref. No. 5X/6006
Voltage regulator (incorporated) Type 1046	...Ref. No. 5UC/4852

INTRODUCTION

1. The rotary inverter, Type 100B, is a 4-pole, compound-wound machine with control panel Type 12 (Rotax F.2801) incorporated. With an input of 25 to 28 V d.c. it gives a nominal output of 115 V, 400 hz 3-phase a.c., 120 W, 0·8 power factor, at a speed of 12000 rev/min. The output voltage is maintained substantially constant by a voltage regulator Type 46.

DESCRIPTION

2. The cylindrical inverter unit is carried in a cradle and surmounts the associated control panel box. The cradle houses the shunt field resistor.

INVERTER UNIT

3. The inverter unit comprises an armature with commutator and slip ring assemblies and a fan encased in two end frames which house the yoke and the pole pieces.

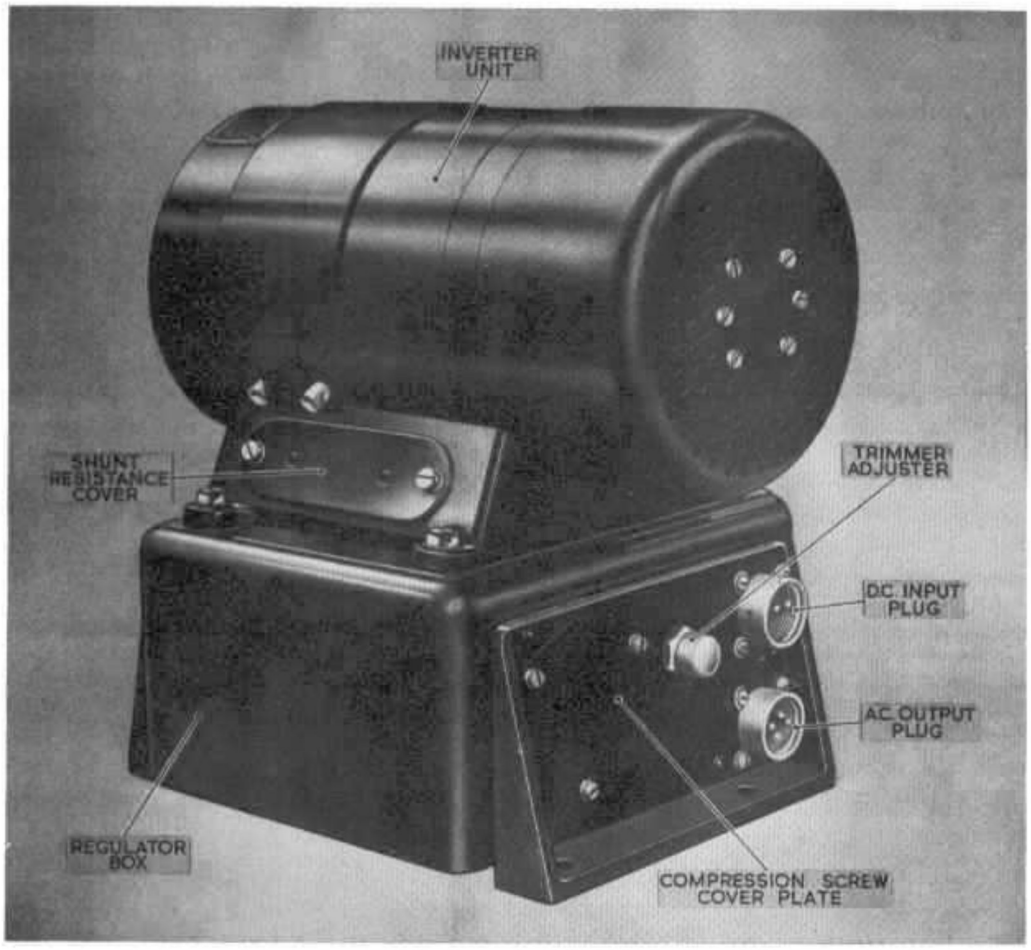

Fig.1 Rotary inverter Type 100B

The commutator-end frame is enclosed by the commutator-end cap, removal of which provides access to the d.c. brushgear while the a.c. brushgear is revealed by removal of the window strap of the slip-ring end frame. The armature shaft is supported by two ball bearings, selectively fitted to give a clearance of 0·0001 to 0·0004 in on the shaft and in the housings. The fan is fitted to the end of the armature shaft. Since the bearing is located by the fan boss, no attempt should be made to run the machine without the fan fitted. Cooling is achieved by the fan, circulation of air being assisted by the perforated ends of the two end frames and the four holes in the slip-ring end frame.

4. The d.c. brushgear at the commutator end is secured by fixing screws through slotted holes in the end frame, the slots providing for adjustment of the brush position. The negative brush terminal is connected directly to one terminal of a terminal block mounted in the control panel box and the other to one end of the series field coil.

5. The four pole pieces are mounted in the bore of the yoke which is integral with the slip-ring end frame and carry the field windings, wound in compound coils. One end of the shunt and one end of the series field are connected to the positive terminal of the terminal block in the control panel box. The other end of the shunt winding is connected to the shunt resistor (housed in the cradle) whilst the remaining end of the series winding is connected to the positive brush terminal (see fig.4).

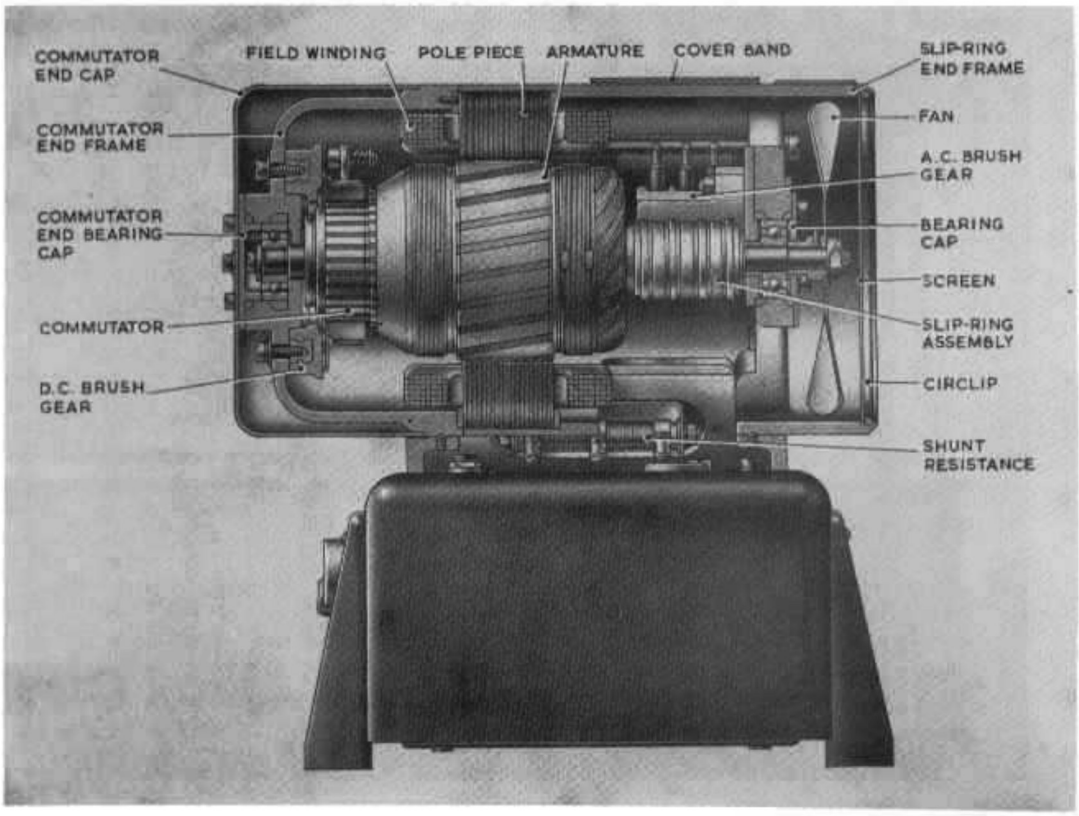

Fig.2 Sectional view of inverter unit

6. The laminated armature has both input and output windings carried in common slots, the 3-phase a.c. winding (27·5 S.W.G.) being nearest to the shaft with the a.c. winding (20 S.W.G.) outside it.

CONTROL PANEL BOX

7. The rectangular control panel box forms the base of the unit and houses voltage regulator Type 46 with its associated ballast and trimmer resistors, a rectifier, a two-stage suppressor (in series with the d.c. input) and the input and output plugs fitted to the end face of the box.

8. Access to components (other than suppressors) is by removal of the base plate. Access to the magnet core and pile compression screw is obtained by removing the appropriate plates on the sides of the control panel box. To enable small voltage adjustments to be made without removal of the base plate, the regulator trimmer resistor (slotted for screwdriver) is brought out through the end face, alongside the input and output plugs.

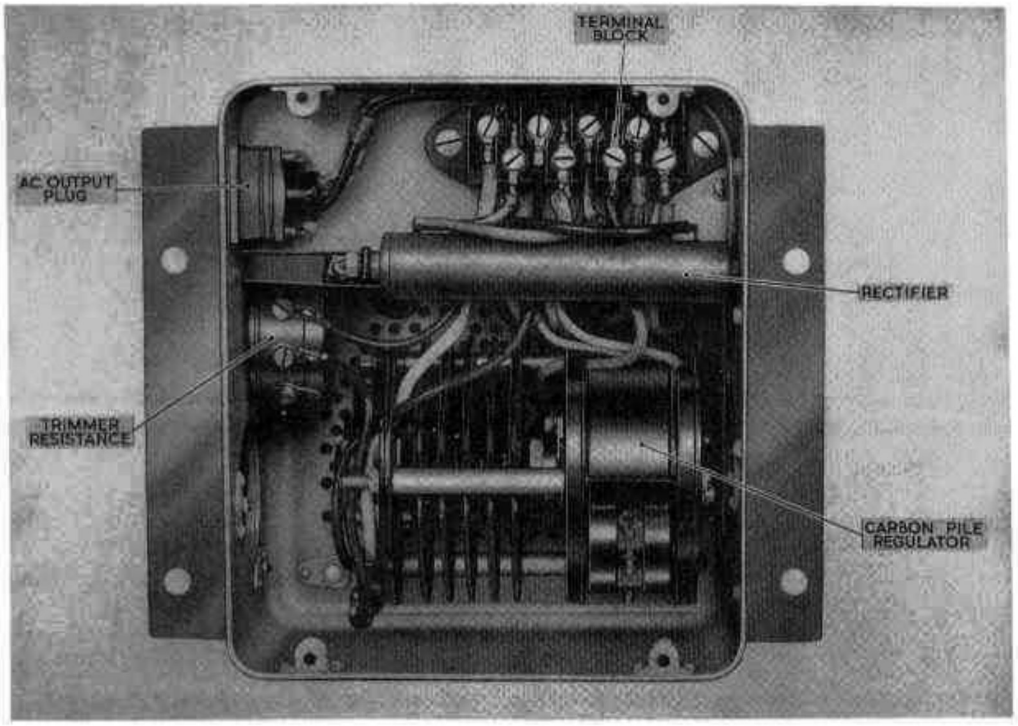

Fig.3 View of regulator, cover removed

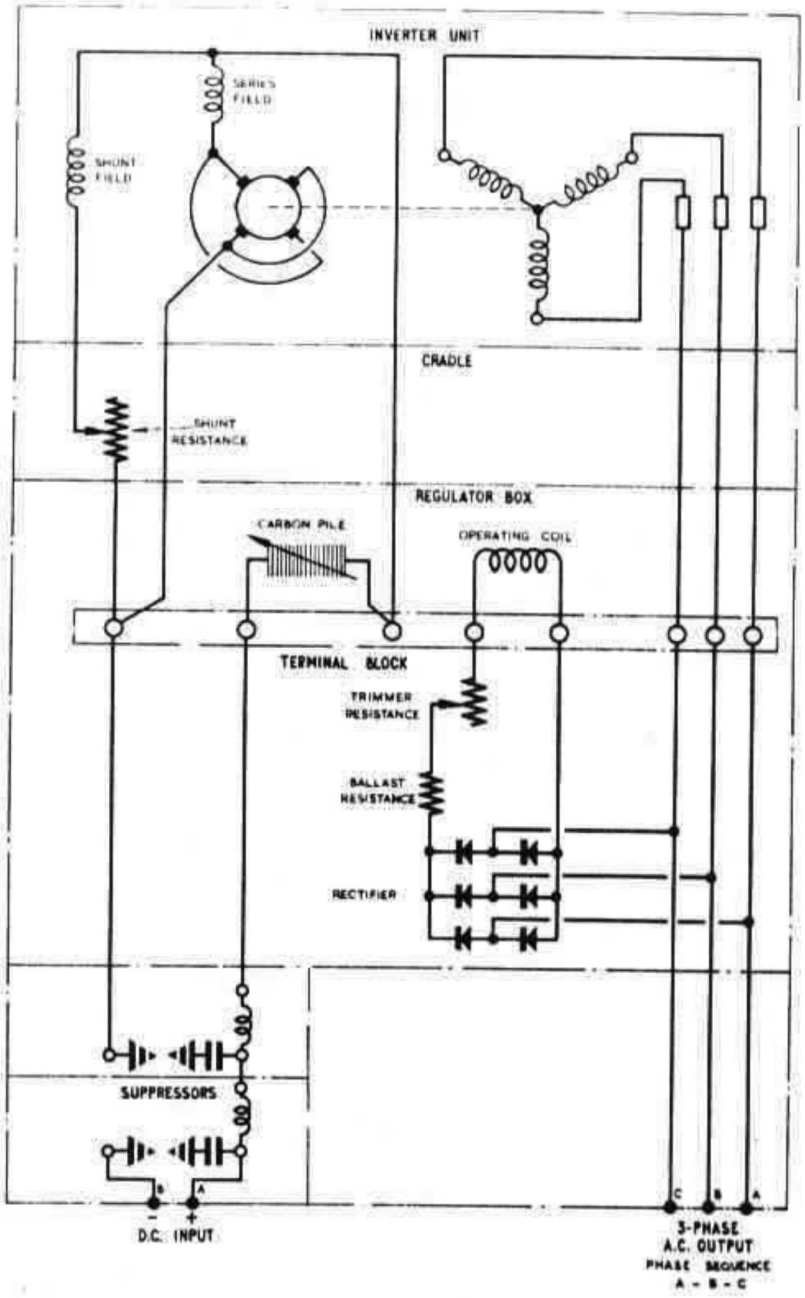

Fig.4 Circuit diagram

CHAPTER 1 -1

ROTARY INVERTER, TYPE 100B (MODIFIED)

LEADING PARTICULARS

Rotary inverter, Type 100B (Modified)	Ref.No. 5UB/6495
Input	25 - 28 V d.c.
Output	(1) 120W, 0·8 p.f., 115V, 400 hz, 3-phase a.c. and (2) 28V d.c. (regulated)
Phase sequence	A-B-C
D.C. brushes	
Grade Nobrac LAB No.F2C	Ref.No. 5UB/5958
Spring pressure	136 to 164 grammes (4·8 to 5·8 oz)
A.C. brushes	
Grade Nobrac LAB No.F2B	Ref.No. 5UB/5959
Spring pressure	21 to 57 grammes (0·75 to 2 oz)
Resistors	
Shunt field (40 ohms) Type ZA.4801/1	Ref.No. 5UB/6058
Trimmer (500 ohms)	Ref.No. 5UB/6297
Ballast (1000 ohms)	Ref.No. 5UB/6819
Rotation (viewed from commutator end)	Counter-clockwise
Dimensions	
Height	7·740 in
Length	7·375 in
Width	5·812 in
Weight	10 lb
Plug, d.c. (2-pole)	Ref.No. Z560050
Plug, a.c. (6-pole)	Ref.No. Z560260
Voltage regulator, Type 1046 (incorporated)	Ref.No. 5UC/4852

ILLUSTRATION

DESCRIPTION

1. This rotary inverter is a modified version of the type 100B (Rotax S.2902) described and illustrated in Chapter 1. Two resistors, with a total resistance of 0·55 ohms have been connected in series with the positive supply to the inverter and a bank of power factor correction capacitors, each of 0·5 μF, connected across the a.c. output lines.

2. The d.c. input is by a 2-pole plug marked INV.1 and the output is taken from a 6-pole socket marked INV.2 disposed at opposite ends of the box. Pins C, D and E of INV.2 are connections for the three phases A, B and C respectively of the inverter 115V a.c. output, pins A and B provide for a regulated 28V d.c. output. Additional connections have also been made within the suppression unit, see circuit diagram fig.1.

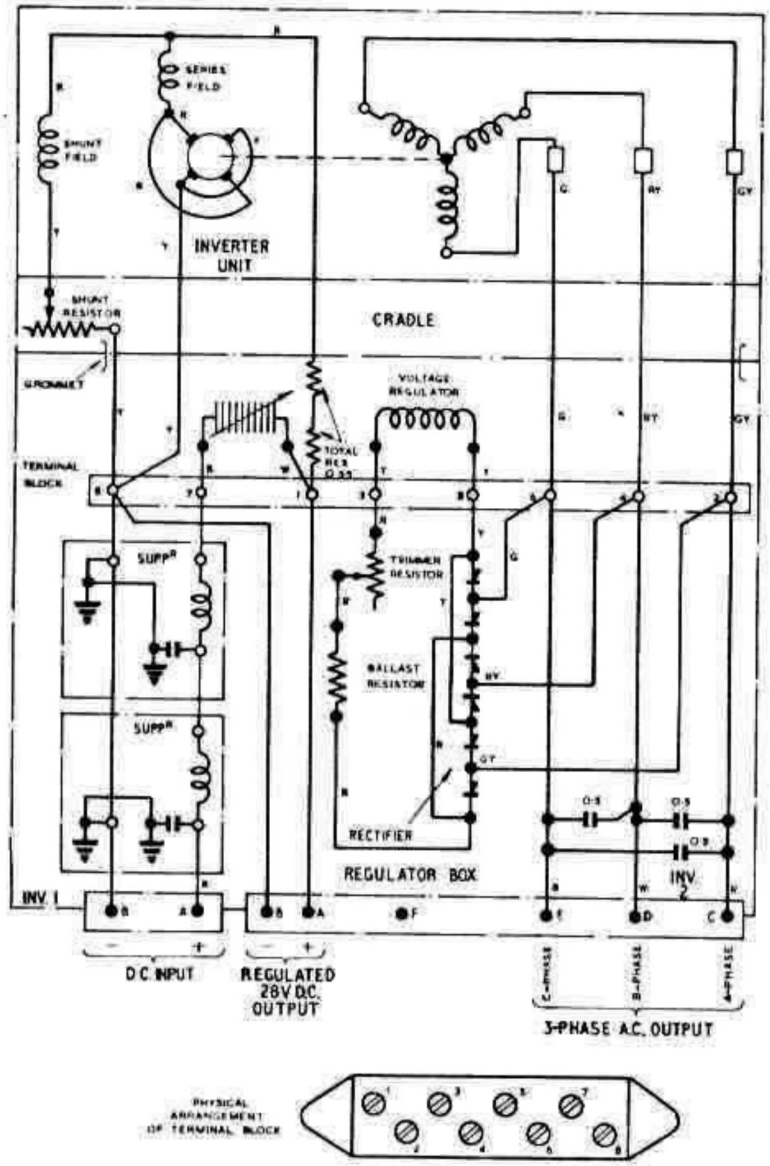

Fig.1 Circuit diagram

CHAPTER 1-2

ROTARY INVERTER, TYPE 100D (Rotax S.2909)

LEADING PARTICULARS

Rotary inverter, Type 100D	Ref.No. 5UB/8353
Input	22 to 28V d.c.
Output	3-phase, 115V, 150W (0·8 p.f.)
Phase sequence	A-B-C
D.C. brushes	
Grade KC5EG11 (part No.N.125843/1)	Ref.No. 5UB/8348
Spring pressure	136 to 164 grammes (4·8 to 5·8 oz)
A.C. brushes	
Grade F2B	Ref.No. 5UB/5959
Spring pressure	21 to 57 grammes (0·75 to 2·0 oz)
Resistors	
Shunt field (40 ohms) ZA.4801/1	Ref.No. 5UB/6058
Trimmer (500 ohms)	Ref.No. 5UB/6297
Ballast (1000 ohms)	Ref.No. 5UB/6819
Rotation (viewed from commutator end)	Counter-clockwise
Dimensions	
Length	7·375 in.
Width	5·812 in.
Height	7·740 in.
Weight	10 lb
Plug, d.c.	Ref.No. 5X/6001
Plug, a.c.	Ref.No. 5X/6006
Voltage regulator Type 1046 (incorporated)	Ref.No. 5UC/4852
Altitude	to 30,000 ft.

GENERAL

1. The inverter Type 100D is similar to the inverter Type 100B, described and illustrated in Chapter 1, except that a different grade of d.c. brushes have been introduced, KC5EG11 to Mod.Elect.B/611 (Rotax R6361). This grade of brush is of the film forming type and general information on brush bedding and commutator servicing is given in A.P.113A-0301-1 (formerly A.P.4343, Vol.1, Sect.1, Chap.1, para.5-6 and 11-18).

2. Servicing, testing and bay servicing for the Type 100D are as detailed in Chapters 1, 2 and 3.

Chapter 2

STANDARD SERVICEABILITY TESTS

CONTENTS

Introduction

1. The following tests should be applied prior to installation or at any time when the serviceability of the unit is suspect.

TEST EQUIPMENT

2. The following test equipment, or suitable equivalents, will be required:-

General

Ref. No.	Description	Purpose/Remarks
5G/9156675	Tester, insulation resistance, Type C	
ZA/6625-99-102-5386	Megohmmeter Type 70154 (ARMY only)	

Fig. 1

Ref. No.	Description	Purpose/Remarks
5Q/9002144	Voltmeter, 0-40V d.c.	V1
5CW/4189	Switch, two pole, on-off	S1
5UB/4939	Control panel, Type 12	-
5CW/6172	Switch, phase selector	S2
5CW/898	Switch, push, Type B No. 1	S3, S4
5Q/4350451	Voltmeter, 0-150V a.c.	V2
5Q/1003731	Frequency meter	F1
5G/565	Inductive loading unit	See Note
5G/3201	Phase rotation indicator	-
--/----	Variable d.c. supply 20 to 35V	-

Note ...

For information on the inductive loading unit refer to AP120E-0403-1.

TEST PROCEDURE

Control panel

Insulation resistance tests

3. Remove base cover, disconnect the earth cable from the terminal block and using Type 'C' insulation resistance tester, measure the insulation resistance between pin 'A' of the two-pole d.c. input plug and the frame. The reading shall be not less than 0·5 megohm. Reconnect the earth cable to the terminal block.

4. Measure the insulation resistance between pin 'A' of the three-pole a.c. output plug and the frame. The reading shall be not less than 2 megohms. Refit the base cover.

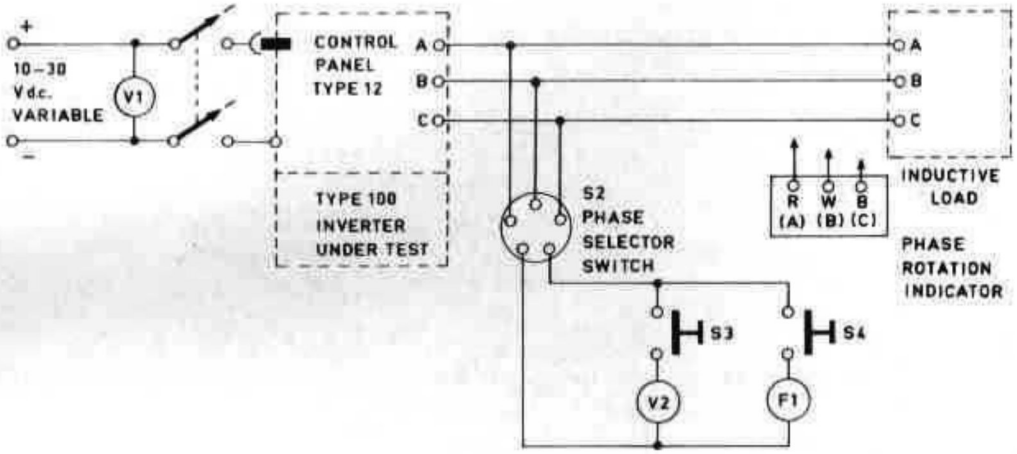

Fig. 1 Test circuit

Inverter

5. Connect the inverter to the test circuit shown in fig. 1 and proceed as detailed in the following paragraphs.

Note ...

The test circuit is identical to that used for testing inverters Type 100A and 100C as detailed in AP113D-0104-16.

Warming up

6. Remove the commutator-end cover. Adjust the input voltage to 27V and run on no load for one hour. Ensure that the a.c. output is between 119 and 121V, adjusting if necessary by means of the trimmer resistor on the control panel. Check that phase sequence is A-B-C using the phase rotation indicator (ref. para. 2).

7. Ensure that the output frequency is 395 Hz; adjustment, if necessary, is to be made by means of the shunt field resistor.

Regulation test

8. Switch 'ON' full load and ensure that the voltage does not fall below 115V.

9. Switch the load 'OFF' and 'ON' three times and ensure that the frequency remains at 395 Hz. If the frequency falls with loading then the brushgear will need to be moved in a clockwise direction and conversely if the frequency increases, the brushgear should be moved counter-clockwise. Adjust frequency, if necessary, to 395 Hz by means of the shunt field resistor. Switch 'Off' load and inverter supply.

10. Switch 'ON' inverter supply and REPEAT operations para. 6, 7, 8 and 9.

11. Increase the input voltage to 35V and ensure that the frequency does not exceed 400 Hz and that the a.c. output voltage does not exceed 121V.

12. Lift each d.c. brush in turn and ensure that the sparking is not excessive at the diametrically opposed brush.

13. Switch off inverter supply and disconnect the test equipment before refitting the commutator-end cover.

CHAPTER 3

BAY SERVICING

CONTENTS

TABLE

ILLUSTRATION

INTRODUCTION

1. The function of this chapter is to describe the Bay Servicing procedures for Rotary Inverters Type 100B(S.2902), the modified version of 100B, and Type 100D (S.2909). Further details of the incorporated control panel, Type 12 (Rotax F.2801) can be found in A.P.113D-0721-16.

SPECIAL TOOLS, MATERIALS AND TEST EQUIPMENT

2. The following tools and test equipment will be required in addition to those called up in Chapter 2.

TOOLS

Ref. No.	
5UA/1201	Tool kit, E.D.G.
	Variable d.c. supply 19 to 35V
5UA/1206	Extractor for fan, complete with pads

MATERIALS

33B/943354	Varnish
33C/890	Glasspaper, grade '00'.
33C/1172	Silicone compound, insulating
34B/9105058	Grease XG-278
34D/467	Trichloroethane
34D/293	Oil, OM-13, lubricating

TEST EQUIPMENT

1H/96	Spring balance, 0 to 2lb.

INITIAL TESTING

3. Prior to Bay Servicing the tests detailed in Chapter 2 should be applied to determine the serviceability of the unit.

CLEANING

4. Clean the inverter, externally, using Trichloroethane on cotton rag.

DISMANTLING

CONTROL PANEL, BASE COVER

5. Withdraw the 6 B.A. screws to remove the base cover.

RECTIFIER (FIG.3)

6. Disconnect the rectifier from the terminal block, identifying the leads to facilitate correct re-assembly. Unscrew and remove the cap nut and shakeproof washer (on the outside of the control panel) and the screw that secures the rectifier bracket at the opposite end. Remove the rectifier from its mounting.

INVERTER

7. Disconnect the remaining six leads from the terminal block and identify the leads to facilitate re-assembly. Remove four 2 B.A. bolts to separate the inverter from the control panel.

COMMUTATOR-END

8. Remove screws to permit removal of the commutator end cap and withdraw four cheesehead screws to remove the commutator-end bearing cap.

BRUSHGEAR

9. Remove the window-strap assembly with the cork liner and the circlip and screen from the slip-ring end.

10. Disconnect the two yellow leads and one red lead from the d.c. brushgear assembly and remove the four d.c. brushes from their boxes. If there is need to remove the d.c. brushgear assembly, identify the position with marks on the back plate and on the end frame.

11. Remove the six a.c. brushes from their boxes by turning the small slotted pins at the top of the brush boxes by one quarter of a turn.

12. Hold the armature stationary and remove the screw, spring washer and plain washer from the commutator end of the armature shaft; the nut and lockwasher which secures the fan at the other end; collect shims.

13. Remove the fan and collar, using extractor 5UA/1206 or suitable alternative with pads. Remove the outer bearing cap.

COMMUTATOR END FRAME

14. Disconnect the field windings and remove the two drawbolts. Withdraw the two bolts that secure the cradle to the commutator-end frame and remove the frame from the yoke to remove the armature.

15. Remove the bearings from the housings. Collect shims from the d.e. end.

CONTROL UNIT

16. Clean the control unit externally, using Trichloroethane and remove the compression-screw cover plate and the magnet-core-screw cover plate.

EXAMINATION AND REPAIR

GENERAL

17. Examine the dismantled components for damage and corrosion; clean where necessary using air blast.

BRUSHGEAR

18. With a Type 'C' insulation resistance tester measure the insulation resistance between the brush holders and the frame. The reading shall be not less than 0·1 megohm.

19. Examine the d.c. brush springs for corrosion and security of attachment; if a white deposit has formed, clean the springs and work a drop of oil OM-13 into the coils of the springs.

20. Measure the brush spring tension with the face of the spring balance level with the top of the brush holder; the reading shall be between 4·75 and 5·75 oz.

ARMATURE

21. Examine the armature for signs of overheating, thrown solder or damage and examine the slip-rings for pitting and security of attachment.

22. Measure the insulation resistance between the commutator and the shaft and between the slip-rings and the shaft. The reading shall be not less than 0·2 megohm.

BEARINGS

23. Clean the bearings with Trichloroethane and dry using air blast. Lubricate the bearing lightly and rotate by hand to detect any roughness. Do not rotate a dry bearing. If roughness is evident, clean again and if the trouble persists renew the bearing.

LUBRICATION

24. Fill the bearing one third full with grease XG-278 and rotate the bearing to distribute the grease evenly.

CONTROL UNIT

25. Examine the terminal block for damage and security of attachment.

26. Use a testmeter to ensure that the contact arm of the trimmer resistance makes good contact over the whole range of movement and set the arm in mid-position.

Regulator

27. Remove the compression screw of the regulator and examine for damage. Slide the pile washers on to the shaft of a small screwdriver and examine for pitting and burning. If any pile washer needs to be renewed, fit a complete pile stack.

Preliminary mechanical setting

28. (1) Unlock the core screw of the regulator and unscrew it until two threads are protruding.

(2) Unlock the pile compression screw and turn 'IN' (clockwise) until the pile is fully compressed but do not use undue force or damage to the pile will result.

(3) Turn the core screw 'IN' (clockwise) until resistance to further movement is felt. This is the flush or zero gap position of the assembly.

(4) Now turn the pile compression screw 'OUT' (counter-clockwise) for three-quarters of a turn and then the core screw 'OUT' one quarter of a turn. Lock both the core screw and the compression screw temporarily to await the procedure for testing (see para. 42).

Breeze plug

29. Examine the breeze plug for corrosion, damage and security of attachment. Lubricate the threads lightly with grease XG-278. If the pins are corroded, clean and then smear lightly with silicone compound.

ASSEMBLY

Bearings

30. Fit the bearings into their housings after greasing (as para. 24), replacing shims.

31. Fit the outer bearing cap at the a.c. end and lock the securing screws with varnish. Fit the armature into the yoke and fit the commutator-end frame to the yoke with the drawbolts. Secure the cradle to the commutator-end frame with two bolts and reconnect the field windings.

Armature

32. Using a new tabwasher, re-assemble the cooling fan into position and refit the commutator-end bearing clamp screw.

33. Fit the bearing shim and refit the outer bearing cap at the commutator end, locking the securing screws with varnish. Fit the fan guard, securing with a new circlip if required.

Brushgear

34. If the d.c. brushgear assembly has been moved, refit in the position

identified during dismantling and fit new brushes.

Inverter

35. Thread the leads of the inverter unit through the grommet in the control unit and, after ensuring that the position is correct, secure with four 2. B. A. screws.

36. Reconnect the six leads to the terminal block.

Rectifier

37. Refit the rectifier to its mounting, connect the leads to the terminal block and lock the screw and nut with varnish.

TESTING

Setting up

38. Connect a 19 to 35V variable d. c. supply to the d. c. input plug with a 0 to 40V voltmeter connected across the d. c. input.

39. Connect the testmeter across pin 'A' and pin 'B' of the a. c. output plug and connect the loading panel 5G/565 across pins 'A', 'B' and 'C' of the a. c. output plug.

Brush bedding

40. The brushes should be pre-bedded as described in AP113A-0308-1, Servicing Technique No. 2. With supply to the inverter adjusted to 27V, run the inverter on 'no load' until the brushes are bedded in over the entire thickness and at least 80 per cent of their axial width.

41. After satisfactory bedding-in, remove all carbon dust (using air blast) and refit the slip-ring cover, locking it with tie-wire.

Regulator adjustment

42. Adjust the voltage of the inverter input supply to 27V and:-

(1) Unlock the core screw and the compression screw.

(2) Turn the compression screw clockwise until the output voltage rises, then watching the voltmeter, turn the screw counter-clockwise until the output voltage reaches a minimum. Then make a further one-eighth of a turn counter-clockwise and switch 'OFF' the inverter supply.

(3) Switch the inverter supply 'ON' and adjust the output voltage to 115V by means of the magnet core screw. Switch 'OFF'.

(4) Switch 'ON' and repeat the operation described in (2).

(5) With the inverter supply 'ON' ensure that the output voltage is between 119 and 121V; failure to achieve these limits will necessitate the repetition of operations (2) and (3). Switch 'OFF'.

(6) Adjust the input supply to 19V and increase the input voltage until

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the output voltage is 115V; ensure that the input voltage is then between 21 and 22·5V.

(7) Increase the input voltage until the output voltage does not increase any further. Ensure that the output voltage is 119 to 121V and note the reading.

(8) Increase the input voltage to 32V and ensure that the output voltage is within 0·5V of the output voltage noted in sub-para.(7). Switch 'OFF'.

Inverter

43. Adjust the input voltage to 27V, switch 'ON' and ensure that the a.c. voltage is between 119 and 121V inclusive. Ensure that the output frequency is 395 Hz, adjustment to meet this requirement is made by means of the shunt field resistor in the inverter cradle.

44. Switch 'ON' full load and ensure that the output voltage does not fall below 115V.

45. Switch the load 'OFF' and 'ON' three times during which the frequency shall be between 393 and 397 Hz. If the frequency falls on load, adjust by moving the brushgear in a clockwise direction until the frequency remains stable. Conversely frequency increase on load is adjusted to stability by counter-clockwise movement of the brushgear.

46. Adjust the frequency, if necessary, to 395 Hz by means of the shunt field resistor. Switch 'OFF' both the load and inverter supply.

47. With input voltage of 32V ensure that the frequency does not exceed 400 Hz and that the a.c. output voltage does not exceed 121V.

Sparking

48. Lift each d.c. brush in turn and ensure that sparking is not excessive at the diametrically opposed brush. Switch 'OFF' and disconnect.

49. Lock the pile compression screws and the magnet core lock screws with varnish and refit the pile compression cover plate and lock the screws with varnish.

Insulation resistance test

50. (1) Disconnect the earth cable from the terminal block and using 250V insulation resistance tester measure the insulation resistance between pin 'A' of the d.c. 2-pole input plug and the frame. The reading shall be not less than 0·5 megohm.

(2) Reconnect the earth cable to the terminal block and using 250V insulation resistance tester measure the insulation resistance between pin 'A' of the 3-pole output plug and the frame. The reading shall be not less than 2 megohms.

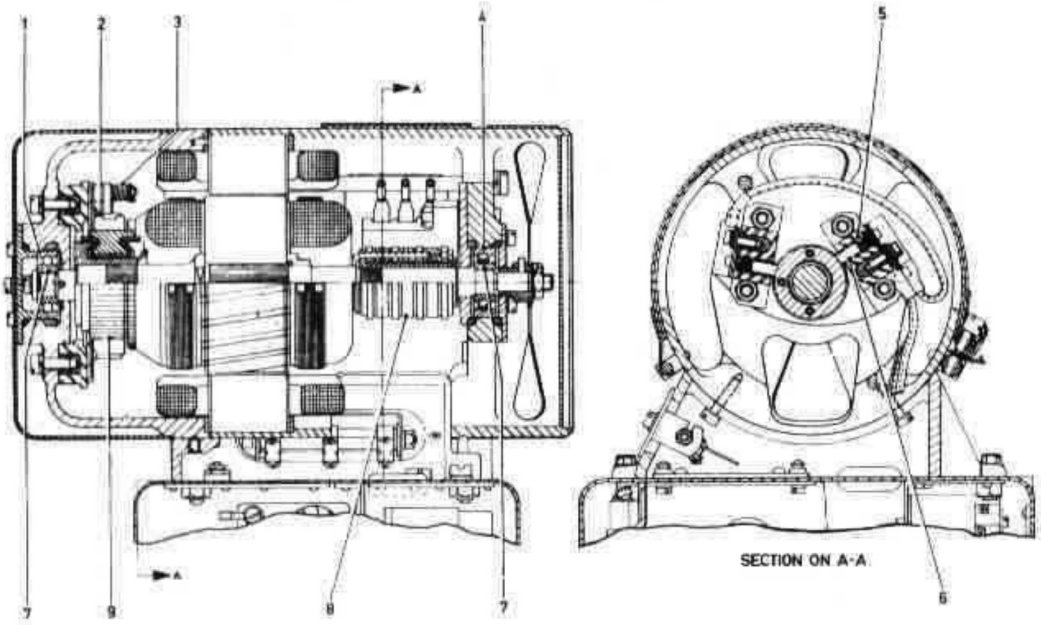

Fig. 1 Diagram of fits and clearances

TABLE 1

Schedule of fits, clearances and repair tolerances for
◄ rotary inverters Type 100B and 100D ►
(all dimensions in inches)

Ref. No. in fig. 1 (1)	Parts and description (2)		Design Dimension (3)	Design Fit (4)	Acceptable worn Dimension (5)	Acceptable worn Fit (6)	Remarks (7)
	BALLRACE IN COMMUTATOR HOUSING						
1	Commutator housing	i/d	0·86640 / 0·86590	0·0001 / 0·0004	0·8667	0·0001 / 0·0006	By selective assembly.
	Ballrace	o/d	0·86615 / 0·86565		0·8653		Renew at each overhaul.
	BRUSH GEAR D. C.						
2	Brush length		0·592 / 0·572 L. S.	-	-	-	Minimum brush length measured from top of long side to arrow head marking = 0·387. Renew at each overhaul.
3	Spring	Spring pressure	5·8 / 4·8 oz 164 / 136 grm	-	-	-	Spring pressure is measured when top of short side of brush is level with top of brush box.
	BALLRACE IN SLIP RING HOUSING						
4	Slip ring housing	i/d	0·86640 / 0·86590	0·0001 / 0·0004	0·8667	0·0001 / 0·0006	By selective assembly.
	Ballrace	o/d	0·86615 / 0·86565		0·8653		Renew at each overhaul

TABLE 1 (continued)

Ref. No. in fig. 1 (1)	Parts and description (2)		Design Dimension (3)	Design Fit (4)	Acceptable worn Dimension (5)	Acceptable worn Fit (6)	Remarks (7)
	BRUSH GEAR A. C.						
5	Spring	Spring pressure	$\frac{0\cdot750}{2\cdot000}$ oz $\frac{21}{56}$ grm	-	-	-	With spring retaining pin just released.
6	Brush length		$\frac{0\cdot353}{0\cdot333}$	-	-	-	Minimum brush length 0·200 measured from top to arrow head marking. Renew at each overhaul.
	BALLRACE ON ARMATURE SHAFT (Commutator end and slip ring end)						
7	Ballrace	i/d	$\frac{0\cdot27570}{0\cdot27520}$	$\frac{0\cdot0001}{0\cdot0004}$	0·2760	$\frac{0\cdot0001}{0\cdot0006}$	By selective assembly.
	Armature shaft	o/d	$\frac{0\cdot27545}{0\cdot27495}$		0·2746		Renew at each overhaul.
	ARMATURE AND FAN ASSEMBLY						
8	Slip rings	o/d	$\frac{0\cdot877}{0\cdot873}$		0·812		Slip rings to be inspected for score or burn marks.
	ARMATURE AND FAN ASSEMBLY						
9	Commutator	o/d	$\frac{1\cdot380}{1\cdot375}$		1·312		Bar to bar lift 0·0001 max. Total commutator eccentricity not to exceed 0·0008.

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Chapter 7

ROTARY INVERTER, TYPE 100B (ROTAX S2902)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Rotary inverter, Type 100B	...Stores Ref. 5UB/4935
Input	25–28 volts d.c.
Output	120 watts 0·8 p.f., 115 volts, 400 c/s, 3-phase a.c.
Phase sequence	A–B–C
D.C. brushes—	
Grade Nobrac LAB No. F2C	Stores Ref. 5UB/5958
Spring pressure	4·8–5·8 oz.
A.C. brushes—	
Grade Nobrac LAB No. F2B	... Stores Ref. 5UB/5959
Spring pressure	0·75–2 oz.
Resistors—	
Shunt field (40 ohms)	Stores Ref. 5UB/5920
or Type ZA.4801/1	Stores Ref. 5UB/6058
Trimmer (500 ohms)	Stores Ref. 10W/7434
Ballast (1,000 ohms)	Stores Ref. 10W/Z.244002
Rotation (viewed from commutator end)	Anti-clockwise
Weight	10 lb.
Voltage regulator, Type 46 (incorporated) ...	Stores Ref. 5UC/4625

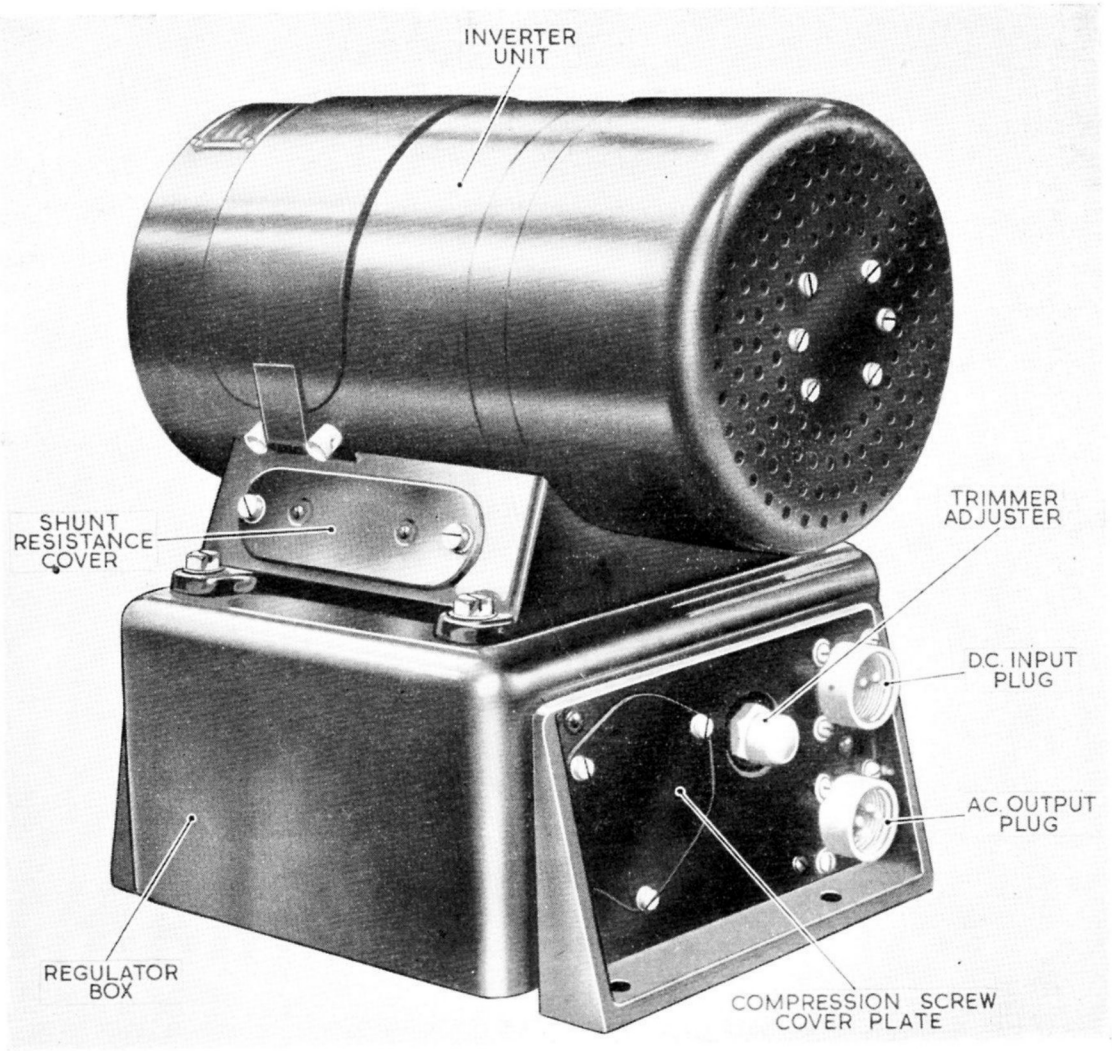

Fig. 1. Rotary inverter, Type 100B

Introduction

1. The rotary inverter, Type 100B, is a 4-pole, compound-wound machine. With an input of 25 to 28 volts d.c., the machine gives a nominal output of 115 volts, 400 c/s, 3-phase a.c., 150 VA, 0·8 power factor, at a speed of 12,000 r.p.m. The output voltage is maintained substantially constant by a voltage regulator, Type 46.

DESCRIPTION

2. The inverter unit (*fig.* 1) is carried in a cradle which houses the shunt field resistor, and is secured to the regulator box by four hex/hd. screws, slotted for screwdriver operation.

Inverter unit

3. The armature shaft, carrying the commutator and slip-ring assemblies (*fig.* 2), is held in two ball bearings, one in the commutator end frame and the other in the slip-ring end frame. The bearings at both the commutator and slip-ring ends have been selectively fitted to give a clearance of 0·0001—0·0004 in. on the armature shaft and in the housings. For this purpose, the bearings and housings are graded A, B, or C, according to their dimensions; to assist identification, housings are marked A, B, or C, and bearings are marked with one, two, or three dots. A 1-dot bearing is used with a grade A housing, a 2-dot bearing with a grade B housing, and a 3-dot bearing with a grade C housing, so ensuring the required clearances.

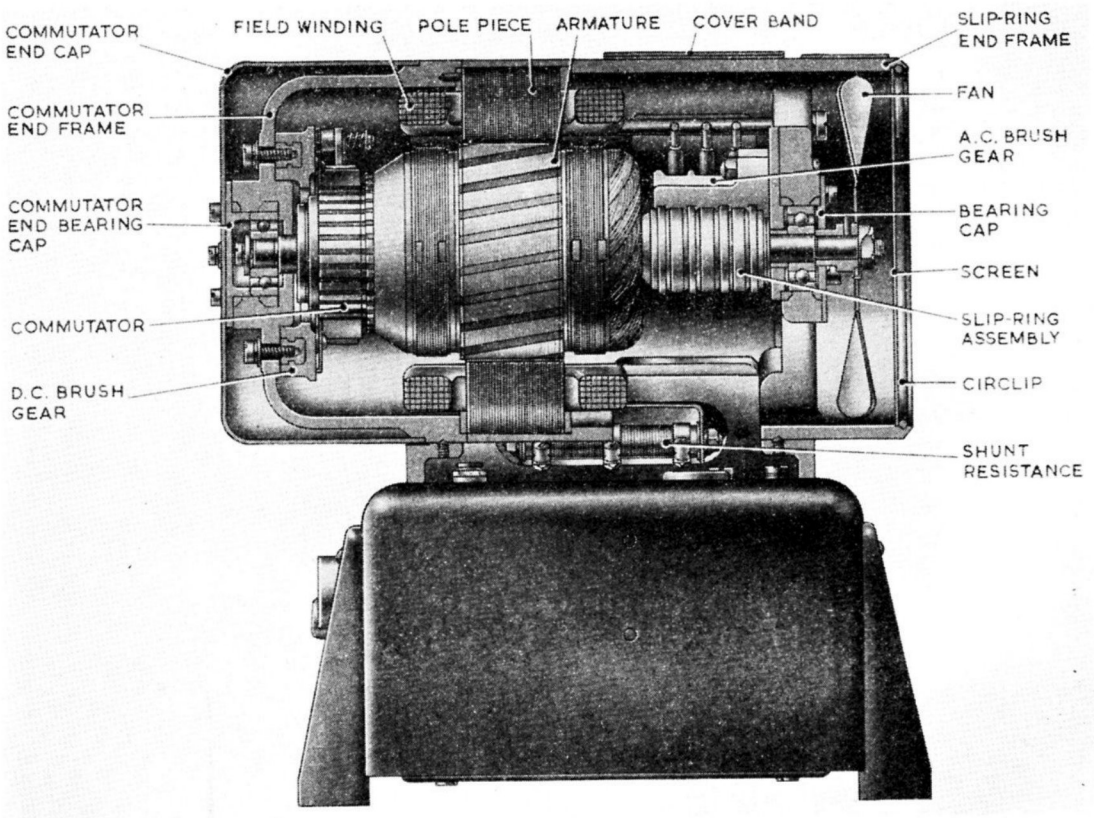

Fig. 2. Sectional view of inverter unit

4. The commutator end bearing cap is secured to the end frame by four ch/hd. screws with spring washers, and is enclosed by the end cap, which is held to the end frame by two ch/hd. screws with plain and spring washers. The end cap is perforated to assist ventilation.

5. At the opposite end, the bearing clamp plate is secured to the slip-ring end frame by four ch/hd. screws, with plain and spring washers. At the other side of the end frame is the bearing cap, held by four ch/hd. screws and washers, and a fan is fitted to the end of the armature shaft and secured by a hexagonal nut and lock-washer. Since the bearing is located by the fan boss, no attempt should be made to run the machine without the fan fitted. A perforated screen is held in position by a circlip sprung into the end frame.

6. Cooling of the machine is effected by the fan at the slip-ring end, circulation of air being assisted by the perforations at each end of the inverter unit and the four holes in the slip-ring end frame. The extension of the frame, which forms the yoke, is slotted, so that cooling air can pass to the regulator box, which has both top and bottom covers perforated.

7. The d.c. brush gear is secured to the commutator end frame by two ch/hd. screws with plain and spring washers; the fixing screws pass through slotted holes in the end frame which allow for adjustment of the brush position. Brush pressure is maintained by springs which are coiled round the trigger posts and bear on the brush triggers. The negative brush terminal is connected directly to one terminal of a terminal block mounted in the regulator box, and the remaining terminal to one end of the series field coil. Access to the d.c. brush gear is gained through holes in the commutator end frame, after removal of the end cap.

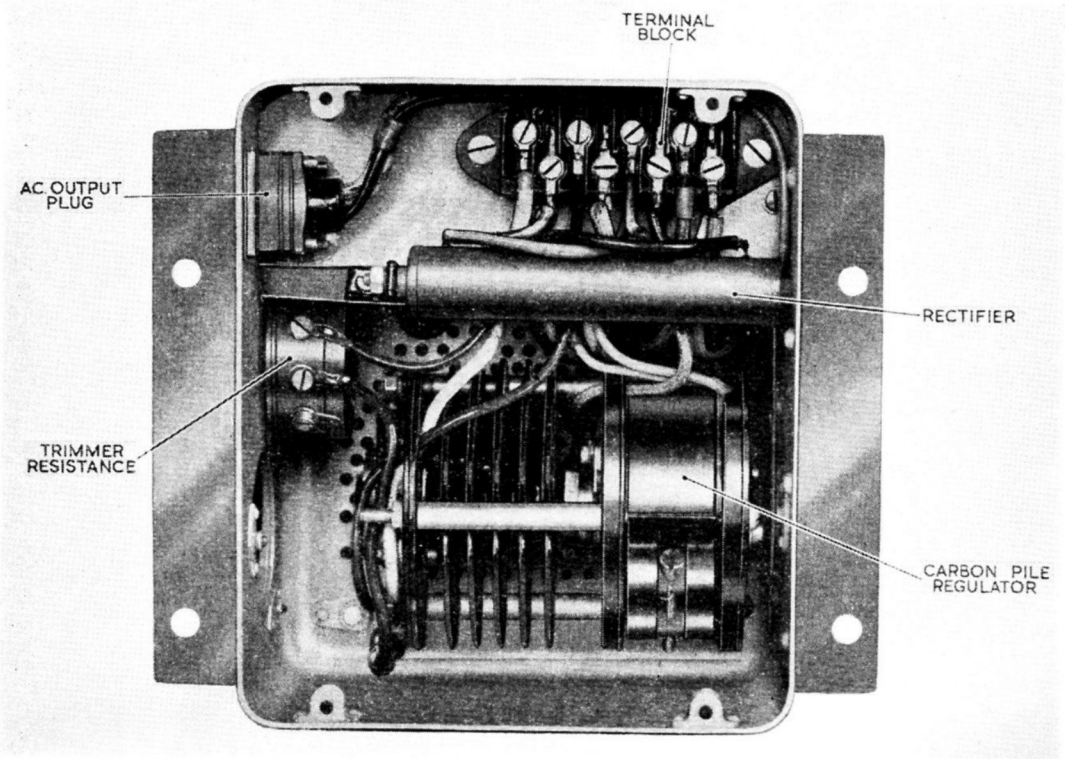

Fig. 3. View with regulator cover removed

8. The four pole pieces are mounted in the bore of the yoke, which is integral with the slip-ring end frame, and carry the field windings, wound in compound coils. One end of the shunt, and one end of the series field winding, are taken to the positive terminal on the block in the regulator box. The other end of the shunt winding is connected to the shunt resistor which is housed in the cradle, whilst the remaining end of the series winding is connected to the positive brush terminal. A circuit diagram for the machine is given in fig. 4.

9. The armature is laminated, and the conductors are carried in skewed slots fitted with slot liners. Both input and output windings are carried in common slots, the 3-phase a.c. winding (27½ S.W.G.) being that nearest the shaft, with the d.c. winding (20 S.W.G.) above it. At the output end, the conductors are brought out to the slip-rings, phase A to ring one, phase B to ring two, and phase C to ring three, in that order, ring one being that nearest the armature. Two bands, each consisting of ten turns of wire, are used to retain the conductors against centrifugal stresses.

10. Access to the slip-ring assembly is gained by removing the cover band. Brush pressure is maintained by coil springs; the outer ends of the springs bear on small copper strips, held in position by, and forming electrical connection to, the brush terminals.

Cradle

11. In the cradle is housed the 40-ohm shunt field resistor, which is fitted with three copper tapping clips, each 0·028 in. thick. Access to the resistor is gained by removing the two ch hd. screws, with plain and spring washers, which secure the plate on which it is mounted.

Regulator box

12. The inverter unit is mounted on a rectangular regulator box (*fig.* 3), which houses a voltage regulator, Type 46, with its associated ballast and trimmer resistors, a rectifier, and a two-stage suppressor in series with the d.c. input. Both the input and output plugs are fitted to the end face of the box. Access to the components housed in the regulator box, with the exception of the suppressors, is obtained by removing the base

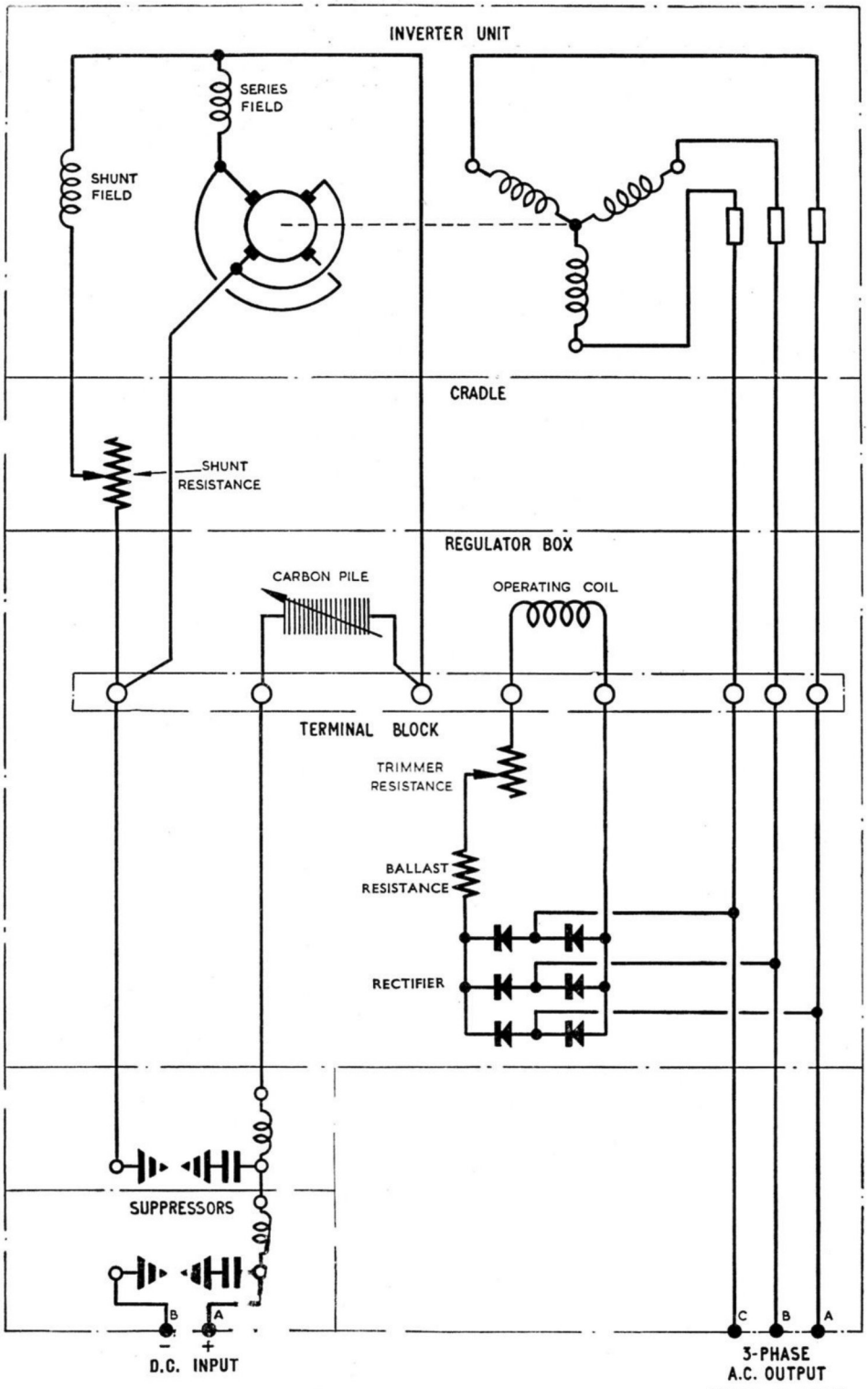

Fig. 4. Circuit diagram

(A.L.211, Dec. 56)

plate, which is held in position by four ch/hd. screws and shakeproof washers.

13. Access to the magnet core and pile compression screw is obtained by removing the appropriate plates on the sides of the regulator box. To enable small voltage adjustments to be made without removing the base plate of the box, the regulator trimmer resistor, which is slotted for screwdriver operation, is brought out through the end face, alongside the input and output plugs.

SERVICING

14. General information on the servicing of inverters will be found in A.P.4343, Vol. 1, Sect. 8. In addition, the following points should be noted.

Bearings and lubrication

15. The bearings are packed with grease XG/275 (Stores *Ref.* 34*B*/100512) on manufacture, and should not normally require attention between major servicing periods.

D.C. brush gear

16. Details of the brush grade and correct spring pressure are given under Leading Particulars; the minimum permissible brush length, measured along the shortest edge, is 0·32 in. The brush springs should be checked for corrosion; if this is present, apply a small drop of oil OM–13 (Stores Ref. 34D/100570), and work the spring until the oil is between the coils.

Note . . .

Care should be taken to ensure that springs in accordance with A.P.1086, Book 3, Part 2 are used.

17. Should it be found necessary to dismantle the brush gear for cleaning, the brush position should be carefully marked before removing the screws securing the brush adjustment. When replacing, ensure that it is set in the original position as follows.

18. When viewed from the commutator end, the centre of each fixing screw should be $\frac{1}{32}$ in. to $\frac{1}{16}$ in. from the centre of the adjusting slot in a clockwise direction. This position will give optimum conditions for commutation.

A.C. brush gear

19. Details of the brush grade and correct spring pressure are given under Leading Particulars; the minimum permissible brush length, measured from the shoulder, is 0·2 in.

20. It is important for the maintenance of brush pressure that the terminal screws should be kept firmly tightened down, as these screws also hold the small copper strips upon which the brush springs bear.

Shunt field resistor

21. Check that the resistor is fitted with copper tapping clips, 0·028 in. thick, and that the clips are secure. Unless a new resistor has been fitted, or it is suspected that the setting has been disturbed, it should not be necessary to adjust the position of the clip. The shunt field resistor should not be regarded as a trimmer resistor, since it has been set to give the correct excitation current, and if disturbed unnecessarily will lead to incorrect speed.

Setting up the inverter

22. The following paragraphs describe the setting-up procedure for this inverter. The setting is very critical, and should be made as accurately as possible to ensure optimum performance of the inverter. It is necessary to obtain a regulation loop of 4 volts between no load and full load; in addition, the frequency should remain substantially constant with a maximum variation of 4 c/s.

23. The inverter tester (Stores Ref. 5G/565), described in A.P.4343S, Vol. 1, Sect. 15, should be used to give the correct test loading. A frequency meter, 300–400–500c/s (Stores Ref. 5Q/154) will also be required, and an a.c. voltmeter, 0–150 volts, suitable for use on 400 c/s, and approved as being of sufficient accuracy for this purpose. A moving coil voltmeter, 0–40 volts, and a moving coil ammeter, 0–30 amp., will be required for measuring the d.c. input to the inverter.

24. It is necessary to provide a d.c. input infinitely variable between 15 and 35 volts. The output from the inverter is taken to the inverter tester, and the a.c. voltmeter connected across any two of the phases.

25. The inverter should have been serviced in the normal manner, particular attention having been paid to the bedding of the brushes and the condition of the voltage regulator armature. Proceed as follows:—

(1) With an input of 27 volts d.c., run the inverter on no load for at least an hour.

(2) With the inverter still on no load, adjust the input to 19 volts d.c. Place the trimmer resistor $\frac{1}{3}$ to $\frac{1}{2}$ of its range up from the minimum voltage position.

(3) Raise the input voltage slowly until the output reads 115 volts a.c., or until no further rise is obtained. The input must now read 21–22·5 volts d.c.

(4) Raise the input to 27 volts d.c. The output must now read 119–121 volts a.c.

(5) Raise the input to 35 volts d.c. The output must remain within ± ½ volt of the figure obtained in sub-para. (4).

(6) Lower the input to 19 volts d.c., and return to 27 volts d.c. Switch on the appropriate load, when the output should drop to not less than 115 volts a.c.

26. If the inverter fails any of the tests in para. 25, the regulator must be correctly adjusted for its dip position as follows:—

(1) Unlock the pile compression screw and magnet core plug.

(2) Switch on the inverter on no load, with the input set at 27 volts d.c.

(3) Turn the pile compression screw in a clockwise direction until the output voltage rises, then turn anti-clockwise until the output voltage just ◄ stops ► dropping. Turn a further ⅛ turn in an anti-clockwise direction, and switch off the inverter.

(4) Switch on the inverter and note the output voltage. Adjust the output to 115 volts a.c. by turning the magnet core plug. (Turn clockwise to lower the voltage and vice versa). Switch off the inverter.

(5) Re-start the inverter and re-check for the dip position as in sub-para. (3). Switch off the inverter.

(6) Re-start the inverter and check the output, which should be 119–121 volts a.c. If not, repeat sub-para. (3), (4), and (5) until this is obtained. Switch off the inverter.

(7) Re-start the inverter, with an input of 19 volts d.c. Raise the input voltage until the output is 115 volts a.c., when the input must be 21–22·5 volts d.c.

(8) Raise the input voltage until the output voltage just stops rising. The output must be 119–121 volts a.c.

(9) Raise the input to 35 volts d.c. The output voltage must remain within ± ½ volt of the figure obtained in sub-para. (8). Switch off the inverter.

(10) Re-start the inverter, with an input of 27 volts d.c. Switch on the load, when the output must be not less than 115 volts a.c. Switch off the load, when the output must be within 119–121 volts a.c. Repeat this test three times.

(11) If these tests cannot be satisfied, the pile stack must be renewed, particular care being taken to ensure that the armature carbon button and the pile compression screw carbon button are unburnt.

Note . . .

When making these tests all tools used must be insulated, and, in addition, the tool for moving the pile compression screw and the magnet core plug must be made from a non-ferrous metal. (Such a tool must be made up locally). When adjusting the pile compression screw and the magnet core plug, ensure that the locking screws are unlocked to the minimum amount, since the re-locking process may disturb the adjustments.

27. (1) Re-start the inverter, with an input of 27 volts d.c., and switch on the load. The frequency should be 395 c/s, and must not rise or fall when the load is switched on and off. If this test is not satisfied, proceed as follows.

(2) Switch off the inverter and inspect all brushes for 100 per cent bedding. If the brushes are not bedded, run the inverter for 4–8 hours until 100 per cent bedding is achieved.

(3) When the brush bedding is satisfactory, switch on the inverter on load. Apply a light finger load to all four brush triggers at once. The frequency should drop; if it does not, the brush spring pressure or sticking brushes will be the cause.

(4) Apply a light finger load to each brush trigger in turn. The frequency should drop in each instance; if it does not, the brush bedding or incorrect brush gear position will be the cause.

(5) Should the frequency fall on load, move the brush gear in a clockwise direction. Switch off the inverter, and re-start on no load. Switch on the load, and note the effect on the frequency. Repeat until the frequency remains substantially stable on and off load. (Should the frequency rise on load, the brush gear must be moved in an anti-clockwise direction).

(6) If necessary, re-set the frequency to 395 c/s by adjusting the shunt field resistor. Repeat sub-para. (5) if the

frequency fluctuates on and off load. Run the inverter for 10 minutes and re-check. It is absolutely essential that the frequency be set at 395 c/s, and remain stable at that figure both on and off load. To this end sub-para. (5) and (6) must be repeated until optimum performance is achieved.

28. This completes the setting-up of the inverter, and para. 25 and para. 27, sub-para. (1) must be repeated to prove the regulation. In addition, raise the input to 35 volts d.c. with the inverter on load, when the frequency should rise to a figure not exceeding 400 c/s, and the output to a figure not exceeding 119–121 volts a.c. Now raise each brush trigger in turn, when the commutation on the opposite brush must remain good with no excessive sparking.

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Mr. Whittaker
Mr. Wood-Barton

November, 1957

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Volume 1

ADMIRALTY
AIR MINISTRY

ELECTRICAL MANUAL, CONTROL AND DISTRIBUTION EQUIPMENT (AIRBORNE)

ADVANCE INFORMATION LEAFLET No.2/57

Insert this leaflet in A.P.4343B, Vol.1, Sect.16, Chap.7, to face para.28.

Line 5. "Inverter on load should read inverter on no load."

Notes

(1) The information contained in this leaflet will be incorporated by normal amendment list action in due course.

(2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in the leaflet is to take precedence.

ENGINEER